#1

# Benchmark Analysis # 2

*Fire in a Large Hall*

*Specification for Part I*

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#2

## Summary of Benchmark Ex # 2

- To further the findings from exercise # 1:
  - comparison with experimental measurements
  - fire within a large space
    - e.g. representative of a turbine hall
- To investigate the influence of modelling assumptions and approaches
  - incorporation of geometrical complexities
    - non-rectangular buildings - compartmentation
- Part I
  - comparison with measurements form fire tests in the VTT test hall
    - undertaken as part of a EU program
- Part II
  - 'hypothetical' simulations for a large fire in a 'real' turbine hall

#3

# Schedule of Activities

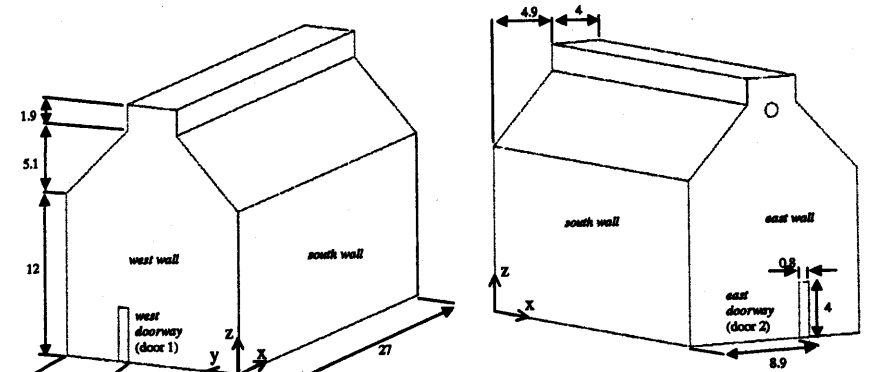
(Parts I and II)

- February 2002
  - release final specification
- February 2002 - September 2002
  - participants to perform simulations
- May 2002 (NIST meeting)
  - present preliminary findings for Part I
  - further discussion of problem definition for Part II
- Early September 2002
  - final results sent to BRE for collation
- October 2002 (BRE meeting)
  - present findings for Parts I and II



#4

# VTT Testing Hall




| Material | Thermal properties | | |
|---|---|---|---|
| | conductivity ($J\,s^{-1}\,m^{-1}\,K^{-1}$) | density ($kg\,m^{-3}$) | specific heat ($J\,kg^{-1}\,K^{-1}$) |
| metal sheet | 54 | 7850 | 425 |
| mineral wool | 0.2 | 500 | 150 |
| concrete | 2 | 2300 | 900 |

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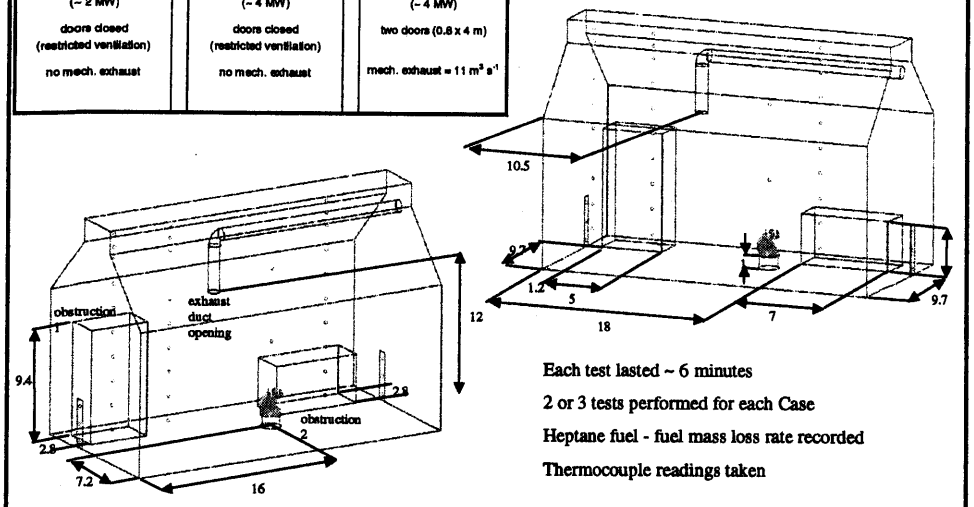
# Internal Geometry and Fire Tests

| Case 1 | Case 2 | Case 3 |
|---|---|---|
| 1.17 m fire diameter (~ 2 MW) | 1.8 m fire diameter (~ 4 MW) | 1.8 m fire diameter (~ 4 MW) |
| doors closed (restricted ventilation) | doors closed (restricted ventilation) | two doors (0.8 x 4 m) |
| no mech. exhaust | no mech. exhaust | mech. exhaust = 11 $m^3 s^{-1}$ |




Each test lasted ~ 6 minutes

2 or 3 tests performed for each Case

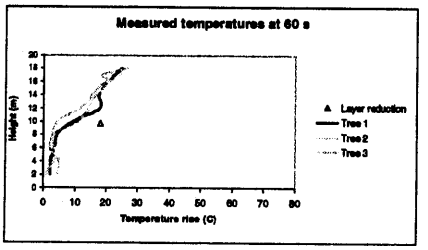
Heptane fuel - fuel mass loss rate recorded

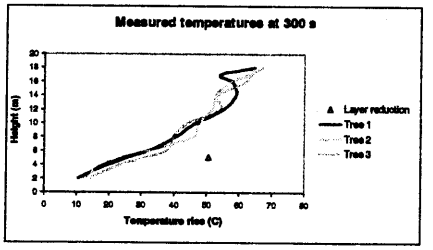
Thermocouple readings taken



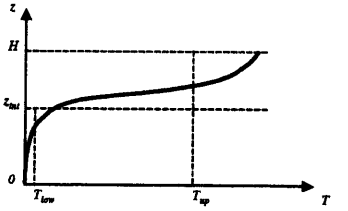
#6

# Derived Upper Layer Temp & Height




Upper layer height and temperature derived from thermocouple readings at three locations (trees)



#7

# Summary of Tasks

| Zone | CFD |
|---|---|
| Heat release rate of fire | Temperatures at thermocouple trees (T1.1,...,T1.10,T2.1,...,T2.10,T3.1,...,T3.10) |
| Interface height | Temperatures at plume thermocouples (TG1.1 & TG.2) |
| Upper layer temperature | Infiltration flow rate (cases 1 & 2) |
| Infiltration flow rate (cases 1 & 2) | Mass flow rate in/out door 1 (case 8) |
| Mass flow rate in/out door 1 (case 8) | Mass flow rate in/out door 2 (case 8) |
| Mass flow rate in/out door 2 (case 8) | Velocities at the two doorways (case8) (V1.1,...,V1.8,V2.1,...,V2.8) |
| Total heat loss rate to solid boundaries | Total heat loss rate to solid boundaries |
| Heat loss through mech. exhaust (case 8) | Heat loss through mech. exhaust (case 8) |
| Plume temperature | Interface height (using reduction of thermocouple tree data) |
| | Upper layer temperature (using reduction of thermocouple tree data) |
| | Total heat release rate (within whole hall) |

Lumped parameter models to include tasks as appropriate